REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	3 June 1993	Final Report, 16-18 May 1993

4. TITLE AND SUBTITLE

Report on Dr. Tamas Varady's Visit to Purdue University, West Lafayette, Illinois

5. FUNDING NUMBERS

F6170893W0569

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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8. PERFORMING ORGANIZATION REPORT NUMBER

SPC-93-4034

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

EOARD
PSC 802 BOX 14
FPO 09499-0200

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

SPC-93-4034

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Describes Dr. Tamas Varady's visit to Purdue University between 16-18 May 1993. He presented a seminar on the current problems of general topology surface modelling (polynomial patches for general topology surface modelling and vertex blending).

14. SUBJECT TERMS

15. NUMBER OF PAGES

2

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

Report

on Dr. Tamas Varady's visit
to Purdue University, West Lafayette, IL
16-18 May, 1993

(Special contract SPC - 93 - 4034)

This visit was organized within the framework of the Window-on-Science program sponsored by the US European Office of Aerospace Research and Development and the Office of Naval Research in London.

Following the invitation of Prof. Christoph M. Hoffmann I visited the Computer Science Department of Purdue University. I had a very thought provoking time in exchanging ideas with the leading researchers of the department in the geometric modelling field, including not only Prof. Chris Hoffmann, but Prof. Chandrajit Bajaj and Prof. Jörg Peters as well. I met also several graduate students, who reported on their current projects.

The most interesting topics and demonstrations include the following:

- E-rep - editable, high-level representation for geometric modelling
- new alternatives for constraint based design
- design of objects based on MAT (Medial Axes Transform)
- definition of free-form objects based on a polyhedron, continuity problems, interpolation and approximation of data points, smoothing
- collaborative multimedia design
- implicit algebraic curves and surfaces

I also met Prof. Dave Anderson at the School of Mechanical Engineering. Discussions were focused on feature extraction for machining, feature based tolerance representation and problems of 5-axis NC manufacturing.

I presented a seminar on the current problems of general topology surface modelling, which was followed by questions, remarks and a discussion. The abstract of the talk can be found in the Appendix.

The visit was a very useful opportunity to exchange ideas in the field of Geometric Modelling and CAD/CAM. I would like to express my gratitude to all individuals and organizations who made this possible.

Mesa, June 3, 1993

Dr. Tamas Varady

Appendix

Polynomial patches for general topology surface modelling
and vertex blending

Dr. Tamas Varady
Geometric Modelling Laboratory
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(at present - Department of Computer Science and Engineering,
Arizona State University)

There are several techniques to interpolate general topology networks of free-from curves. These networks contain n-sided regions and nodes with n ingoing edges, where n is not restricted to be four as in case of regular grids. Most of the known solutions are based on special surface formulations, which cannot be directly converted into the standard representations of Bezier or B-spline surfaces. In fact this is an important issue, since geometric data must be exchanged between different CAD systems and intersections/interrogations possibly should be computed by standard libraries not by specific routines.

After a short introduction to the whole area the problems of using polynomial patches will be described, concentrating on how positional and cross-derivative constraints of an n-sided patch can be satisfied. The other crucial issue to be discussed is the setting of twist vectors at the nodes of the network, including the original nodes and the ones created artificially in the middle of the n-sided patches. The technique presented is directly applicable to curvenet interpolation.

Another related problem is that of vertex blending, when n blended edges must meet smoothly at a vertex of a geometric model. Certain boundaries are defined by the edge blends themselves, other ones are just constrained along the so-called spring curves, which lie on the primitive faces to be blended. The requirements of vertex blending are followed by a special n-sided patch construction, based on the previous considerations.